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(71) Applicant: **SUMITOMO ELECTRIC INDUSTRIES, LTD.**
5-33, Kitahama 4-chome, Chuo-ku
Osaka-shi, Osaka 541(JP)

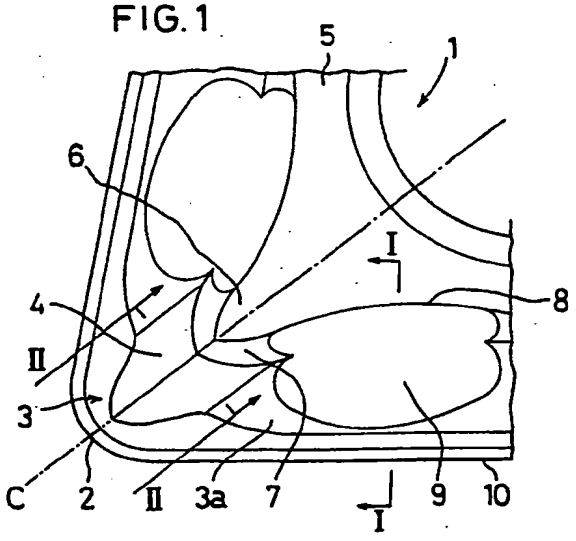
(72) Inventor: **Takahashi, Nobuhiro, Itami Works of Sumimoto Electric Ind. Ltd. 1-1, Koyakita 1-chome**
Itami-shi, Hyogo(JP)

(74) Representative: **Glawe, Delfs, Moll & Partner Patentanwälte**
Postfach 26 01 62 Liebherrstrasse 20
W-8000 München 26(DE)

(54) Throw away insert.

(57) A polygonal throw away insert (1) having a cutting edge (2), a center land (5) and a breaker groove (9) formed between the cutting edge and the center land. It is further formed with pairs of slopes (4) in the breaker groove near its noses, each pair extending obliquely at an angle of 5 - 20 degrees in symmetrical relation with each other with respect to each of the bisectors of the nose to form a ridge therebetween, breaker protrusions (6) extending from the center land toward the noses and having a tapered end, breaker walls (7) extending obliquely upwardly from the rear end of the pairs of slopes to the front end of the breaker protrusions (6), and ellipsoidal grooves formed in the breaker grooves so as to be continuous with the breaker walls.

FIG. 1



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THROW AWAY INSERT

This invention relates to a throw away insert, and more specifically an improvement in chip breaker for smooth chip disposal in a region between the medium cutting region and the heavy cutting region.

In cutting operations, it is extremely important to break and discharge the chips smoothly for better workability. To achieve this, various chip breakers have been developed. It has been a common practice to contemplate three cutting regions, i.e. those for light cutting, medium cutting and heavy cutting according to the cutting conditions (cutting speed, feed rate, and depth of cut) as shown in Fig. 4 and develop a chip breaker suited for each cutting region. But because of a lower depth of cut due to improvements in dimensional accuracy of the material and of an increased feed rate, new cutting regions, which are not covered by any of the abovesaid cutting regions, tend to appear.

These new regions are two regions which, in a new high-feed rate region shown in Fig. 4, do not overlap the medium cutting region nor the heavy cutting region.

The more important among the two regions is the one having a higher feed rate than the medium cutting region and a smaller depth of cut than. the high cutting region, that is, the hatched region in Fig. 4. This is because the chips produced in this region tend to be thicker and more difficult to break. Thus the development of a chip breaker which is effective for this new region has been expected.

Prior art throw away inserts disclosed in Japanese Examined Utility Model Publications 57-30004 and 1-15442 can be used in both the light cutting region and the medium one. But these inserts have the following problems.

While the depth of cut is small enough to be within the nose radius, the chips are discharged substantially in the direction of bisector of the nose angle. It is well known that as the depth of cut increases, the direction in which the chips are discharged approaches the direction in which the straight portion of the cutting edge extends (opposite to the feed direction).

For the new high-feed rate region where the depth of cut is 1 - 5 mm and the feed rate is 0.3 - 0.7 mm/rev., an insert having a nose radius of 1.2 - 1.6 mm is ordinarily used. In such a case, as the depth of cut increases, the chip discharge angle θ will change from the state shown in Fig. 5 where the depth of cut is small (1 - 2 mm) to the state shown in Fig. 6 where it is large (4 - 5 mm).

For a medium feed rate (f = 0.3 - 0.4 mm/rev.), a narrower chip breaker as shown in Fig. 7 is preferable, whereas for a high feed rate, a wider chip breaker as shown in Fig. 8 is effective because the chips produced in such a state tend to be thick and difficult to break.

Since, as described above, the direction in which the chips are discharged changes with the depth of cut and the optimum width of chip breaker changes with the feed rate, it was very difficult to design a chip breaker which can be used not only in the conventional cutting regions but also in the new regions where the depth of cut is small and the feed rate is high.

The throw away inserts disclosed in the abovementioned publications are both provided in a breaker groove formed near each corner with a protrusion extending toward the tip of the nose to expand the chip disposable region. But because such a protrusion narrows the width of the chip breaker, it tends to cause chip clogging at high feed rate. Thus, with these inserts, the cutting area can be expanded from the low cutting region toward the medium one to some extent. But they cannot be used in the heavy cutting region where the feed rate is high.

It is an object of the present invention to provide a throw away insert having a chip breaker which allows the insert to be used in the new region shown in Fig. 4.

In accordance with the present invention, there is provided a throw away insert having a cutting edge, a center land and a breaker groove formed between the cutting edge and the center land, characterized in that a pair of slopes are formed in the breaker groove near each of noses of the insert, the slopes extending obliquely at an angle of 5 - 20 degrees in a symmetrical relation with each other with respect to the bisector of each nose to form a ridge therebetween, breaker protrusions extending from the center land toward each of the noses and having a tapered end, breaker walls extending obliquely upwardly form the rear end of the each pair of slopes to the front end of the breaker protrusions, and ellipsodal grooves formed in the breaker groove so as to be continuous with the breaker walls.

With the throw away insert according to the present invention, the chip discharge angle changes according to the cutting conditions, so that the relative breaker width (the distance between the point where chips form and the point where chips collide) can be adjusted to optimum value. Such conditions are described below more specifically.

[while the depth of cut is small (d = 1.0 - 2.0 mm)]

While the feed rate is within an ordinary range (f = 0.3 - 0.4 mm/rev.), chips formed near a nose 2 show a tendency to flow out into a line C. But, due to the guiding effect of slopes 4 formed at the front side with respect to the direction of feed, their discharge angle will reduce gradually until they collide against breaker walls 7 provided ahead of a breaker protrusion. The chips then curl and get broken.

While the feed rate is high (f = 0.5 - 0.7 mm/rev.), the chips are guided by the slopes 4 in the same manner, colliding the breaker walls 7. But because the chips are rather thick and difficult to break in this case, they are guided along the walls 7 so as to flow into grooves 9 continuous with the terminal ends of the walls 7. The chips are broken when subjected to strain by a convexed surface 9a of each groove 9 near a center land (Fig. 2). Accordingly, the chips formed while the feed rate is high is curled with a larger radius of curvature than the chips formed during normal feed rate. This makes it possible to discharge even thick chips smoothly and thus to prevent clogging with chips.

[while the depth of cut is large (d = 4 - 5 mm)]

While the feed rate is within an ordinary range (f = 0.3 - 0.4), due to smaller guiding action by the slopes 4, the chip discharge angle is only slightly smaller than the angle shown in Fig. 6, i.e. 90 degrees. Anyhow, the chips are curled and broken by colliding against the breaker walls 7 provided ahead with respect to the direction of feed.

When the feed rate is high (f = 0.5 - 0.7), thicker chips show a stronger tendency to flow along the surface of the insert than thin ones. Thus the slopes 4 have a stronger guiding effect while the feed rate is high. Accordingly, the chips are curled mainly on the concave 9a of the groove 9. This serves to increase the relative breaker width, thus allowing the chips to smoothly curl and break.

By the combined action of the slopes 4, the breaker walls 7 of the breaker protrusion and the ellipsoidal grooves 9, chips can be disposed according to the cutting conditions. Thus the throw away insert according to the present invention can cover not only the new high-feed rate region shown in Fig. 4, but also other new regions which are expected to increase more and more.

With the throw away insert according to this invention, by suitably combining the slopes formed in the breaker groove near the nose to form a ridge, the breaker protrusion continuous with the slopes and the ellipsoidal grooves, thinner chips which are produced while the feed rate is low, can be disposed when they collide against the breaker walls provided at the tip of the breaker protrusion, whereas thicker ones, which are produced while the feed rate is high, can be disposed in the ellipsoidal grooves provided ahead of the breaker walls with respect to the direction of discharge. This makes it possible to discharge chips without the fear of clogging. Also, smooth cutting operation becomes possible in the new high-feed rate region including the region where the depth of cut is small and the feed rate is high.

Other features and objects of the present invention will become apparent from the following description taken with reference to the accompanying drawings, in which:

Fig. 1 is a plan view of a portion of the first embodiment;

Fig. 2 is a sectional view taken along line I-I of Fig. 1;

Fig. 3 is a sectional view taken along line II-II of Fig. 1;

Fig. 4 is a graph showing the regions which the insert of the first embodiment can cover;

Figs. 5 and 6 are plan views showing the chip discharge directions when the depth of cut is small and large, respectively;

Figs. 7 and 8 are sectional views showing how the chips are discharged when the feed rate is low and high, respectively;

Figs. 9 and 10 are sectional views showing modified ridges; and

Figs. 11 and 12 are plan views of other embodiments have modified breaker protrusions.

Fig. 1 shows the preferred embodiment of the throw away insert according to this invention. Its basic structure is as described above. The slopes 4 of this throw away insert 1 should be inclined at an angle of $5^\circ \leq \theta_1 \leq 20^\circ$. If the angle of inclination is less than 5 degrees, the effect of adjusting the chip discharge angle may be insufficient while the feed rate is low. If it is more than 20 degrees, the chips will not flow smoothly while the feed rate is high and the depth of cut is large.

Figs. 9 and 10 show different types of ridges defined by the slopes 4. As shown in Fig. 9 by providing a flat portion 11 along the top edge of the ridge, when the depth of cut is small (d = 1.0 mm), the chips will flow on the line C, not affected by the slope 4, and abut the breaker walls 7 taking the shortest course. Thus the chips can easily curl and break. The flat portion 11 should have a width of preferably 0.1 - 0.2 mm. If it is too narrow, it will not be effective wheres if too wide, the area of the slope 4 will unduly decrease.

As shown in Fig. 10, the ridge may be formed along its top edge with a curved surface 12 having a radius of curvature R of 0.2 - 0.5 mm. It has the same function as the flat portion 11.

In order to guide thicker chips into the ellipsoidal grooves 9, the breaker protrusion 6 should have its tip tapered so that the breaker walls 7 will form a given angle with respect to the straight portion 10 of each cutting edge, as shown in Fig. 1.

To achieve this, the breaker protrusion 6 shown in Fig. 11 has its tip curved with a radius of curvature of 0.2 -0.5 mm and is formed with ridge lines continuous with the tip and extending at an angle of θ_2 with respect to the straight edges 10 (its range is preferably $1^\circ \leqq \theta_2 < \theta_0/2$).

The breaker protrusion 6 shown in Fig. 12 has a point angle which is smaller by $2^\bullet\theta_3$) than the angle θ_0 and is provided with ridge lines extending at an angle $\theta_2(> \theta_3)$ with respect to the straight cutting edges 10.

The ellipsoidal grooves 9 open to both breaker groove bottoms 3a and the breaker walls 7. In the embodiment shown in Fig. 1, the grooves 9 are provided so that the intersecting lines between the groove surfaces and the top surface will form ridge lines 8 extending along the grooves.

Claims

1. A throw away insert having a cutting edge, a center land and a breaker groove formed between said cutting edge and said center land, characterized in that a pair of slopes are formed in said breaker groove near each of noses of said insert, said slopes extending obliquely at an angle of 5 - 20 degrees in a symmetrical relation with each other with respect to the bisector of each nose to form a ridge therebetween, breaker protrusions extending from said center land toward each of said noses and having a tapered end, breaker walls extending obliquely upwardly from the rear end of said each pair of slopes to the front end of said breaker protrusions, and ellipsodal grooves formed in said breaker groove so as to be continuous with said breaker walls.

2. A throw away insert as claimed in claim 1, wherein said ridge is formed along its top edge with a narrow flat portion.

3. A throw away insert as claimed in claim 1, wherein said ridge is formed along its top edge with a curved surface having a small radius of curvature.

4. A throw away insert as claimed in any of claims 1 -3, wherein said protrusion has a tip having a small radius of curvature and is formed with ridge lines continuous with said tip and extending at an angle of θ_2(= 1° − 1/2 of the nose angle) with respect to the straight portion of said cutting edge.

5. A throw away insert as claimed in any claims 1 - 3, wherein said each breaker protrusion has a point angle smaller than the nose angle by $2^\bullet\theta_3(\theta_3$ = -5~10°) and is formed with ridge lines continuous with its tip and extending at an angle of $\theta_2(> \theta_3)$ with respect to the straight portion of said cutting edge.

FIG. 1

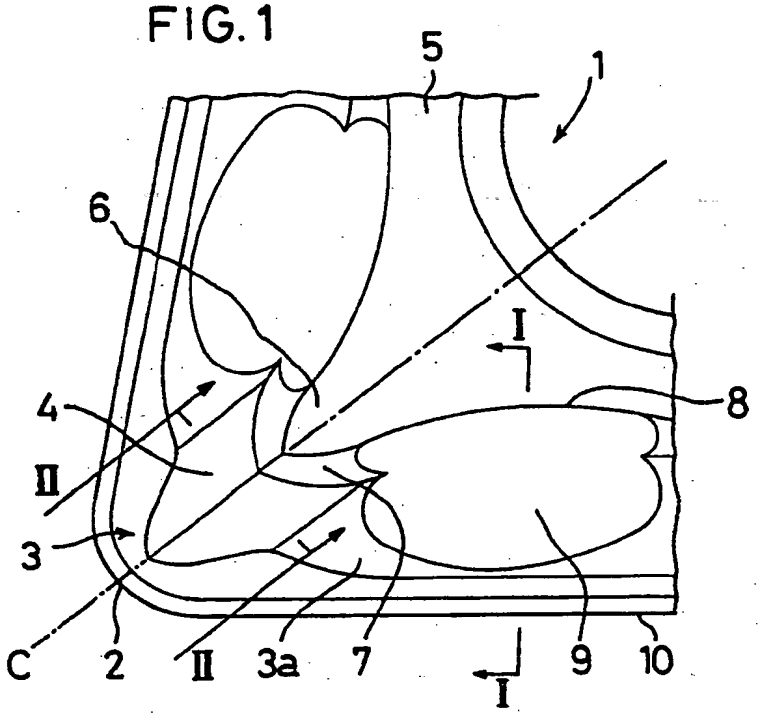


FIG. 4

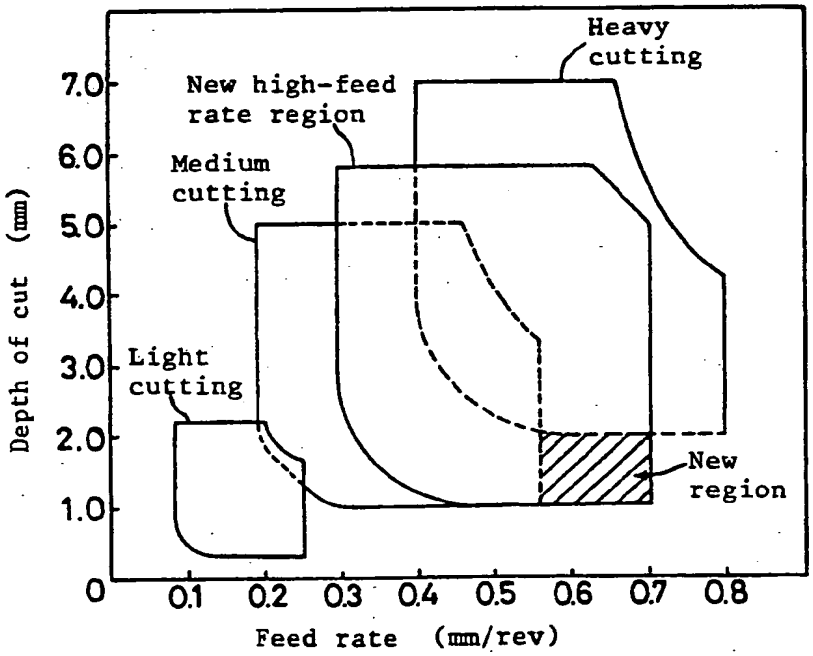


FIG. 5

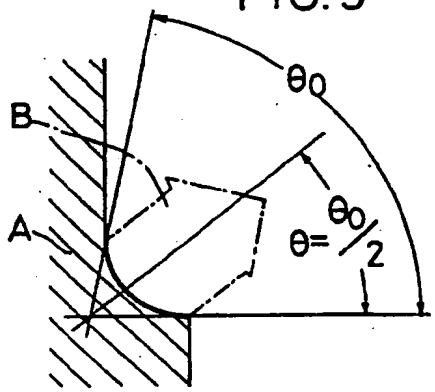


FIG. 6

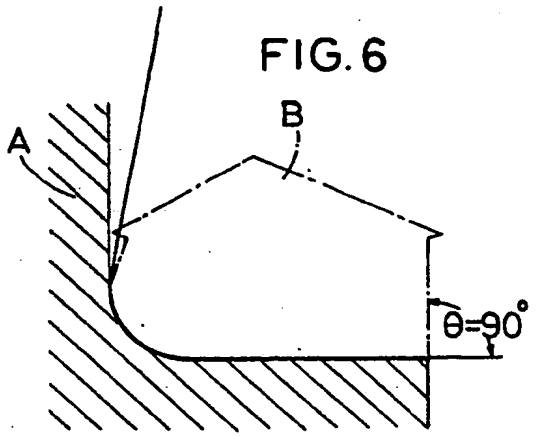


FIG. 7

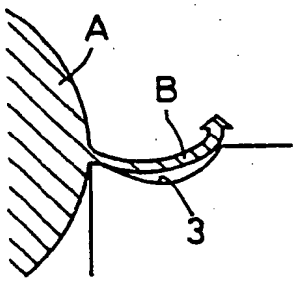


FIG. 8

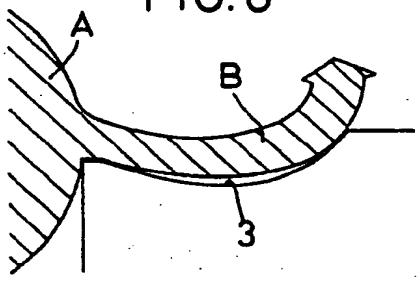


FIG. 9

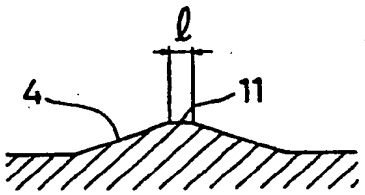


FIG. 10

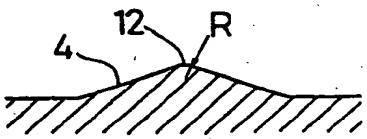


FIG. 11

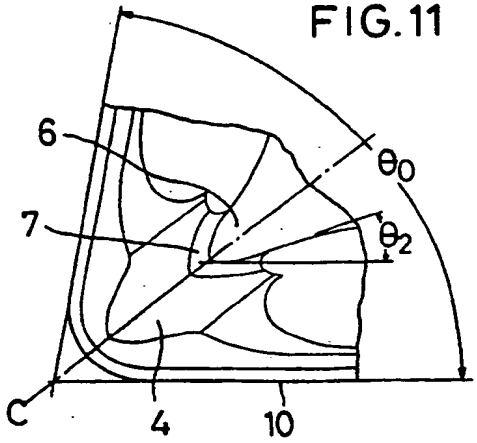
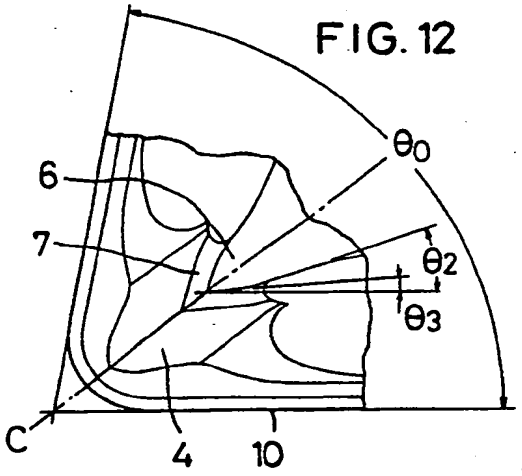


FIG. 12



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EUROPEAN SEARCH REPORT

Application Number

EP 90 11 6764

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
P,A	EP-A-0 345 560 (MAPAL) * Column 3, lines 11-48; figures 1-3 *	1,2	B 23 B 27/14
A	FR-A-2 223 122 (STELLRAM)		

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

B 23 B 27/00
B 23 C 5/00

The present search report has been drawn up for all claims

Place of search	Date of completion of search	Examiner
The Hague	17 December 90	BOGAERT F.L.

CATEGORY OF CITED DOCUMENTS

X: particularly relevant if taken alone
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